

SOOTS*

First listed in the *First Annual Report on Carcinogens*

CARCINOGENICITY

Soots are *known to be human carcinogens* based on sufficient evidence of carcinogenicity of soot in humans (IARC S.7, 1987). Evidence for an increased skin cancer risk, particularly of the scrotum, is demonstrated by numerous case reports, dating back over 200 years, among chimney sweeps. More recent cohort studies of mortality among chimney sweeps have shown a significantly increased risk of lung cancer. Supporting evidence for an association with lung cancer was provided by two earlier epidemiological studies. The potentially confounding and interactive effects of smoking could not be evaluated; however, cigarette smoking is not believed to have seriously biased these estimates. In addition to lung cancer, statistically significant excess mortality from esophageal cancer, primary liver cancer, and leukemia was found among chimney sweeps in one study (IARC S.7, 1987).

There is inadequate evidence for the carcinogenicity of soots in experimental animals (IARC V.3, 1973; IARC S.4, 1982; IARC V.33, 1984; IARC V.34, 1984; IARC V.35, 1985; IARC S.7, 1987). In two studies in mice, when administered topically, a coal-derived soot extract induced skin carcinomas and papillomas in both male and female mice. Coal-derived soot was tested in two experiments in mice by whole-body exposure, but the studies were inadequate for evaluation. A wood-soot extract applied to the skin of mice was inadequately tested. In limited studies, subcutaneous implants of wood soot in female rats produced a few local sarcomas; similar implants in the scrotal sac of rats did not. An extract of fuel oil soot was inadequately tested by application to the skin of mice. Extracts of soot from the combustion of oil shale produced skin papillomas and carcinomas in mice after dermal application and lung carcinomas in rats after intratracheal instillation. Extracts of soot from the combustion of a heating oil produced from shale oil produced skin papillomas and carcinomas in mice in two experiments when applied to the skin (IARC S.7, 1987). Analyses of various soots reveal the presence of a number of known carcinogens and potentially carcinogenic chemicals that are in the *Ninth Report on Carcinogens*, including arsenic, cadmium, chromium, nickel, benz[a]anthracene, benzo[a]pyrene, dibenz[a,h]anthracene, and indeno[1,2,3-*cd*]pyrene (see Arsenic, Cadmium, and Chromium in Section III.A and Nickel and Polycyclic Aromatic Hydrocarbons, 15 Listings, in Section III.B).

PROPERTIES

Soots are generally lusterless, black substances that are by-products of the incomplete combustion or pyrolysis of carbon-containing materials. Soots consist of variable quantities of carbonaceous and inorganic solids with absorbed and occluded organic tars and resins. Most soots contain inorganic matter such as oxides, salts, metals, absorbed liquids and gases, sulfur, and nitrogen compounds; organic compounds, such as polycyclic aromatic hydrocarbons, their derivatives, and their heterocyclic analogues, that can be extracted with organic solvents (methylene chloride or benzene); and insoluble carbonaceous matter consisting of resins and/or incompletely carbonized fuel fragments.

* There is no separate CAS registry number assigned to soots.

USE

Soots are primarily used in the recovery of trace metals in the metallurgical industry. Soots have also been used as fertilizers after weathering to allow acid to leach away or be neutralized by the ammonium compounds and other bases (IARC V.35, 1985). The fertilizing action is probably due to its nitrogen and trace metals content.

PRODUCTION

Soots are not produced commercially in the United States, but they occur as by-products of the incomplete combustion or pyrolysis of carbon-containing materials.

EXPOSURE

The primary routes of potential human exposure to soots are inhalation, ingestion, and dermal contact. There is potential occupational exposure to soot for chimney sweeps, heating-unit service personnel, brick masons and helpers, building demolition personnel, insulators, firemen, metallurgical workers, and horticulturists. The general population is potentially exposed to soots since they are widespread environmental contaminants.

REGULATIONS

EPA has prescribed guidelines for the thermal processing of solid wastes containing soot. Under the Resource Conservation and Recovery Act (RCRA), wastes containing soots are subject to report/recordkeeping requirements under the hazardous waste disposal rule. OSHA also regulates soots as chemical hazards in laboratories under the Hazard Communication Standard. Regulations are summarized in Volume II, Table A-36.